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IS 11115 (1999): Earth-Moving Machinery - Human Physical Dimensions of Operators and Minimum Operator Space Envelope [MED 7: Material Handling Systems and Equipment]



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(दूसरा पुनरीक्षण)

Indian Standard

EARTH-MOVING MACHINERY — HUMAN
PHYSICAL DIMENSIONS OF OPERATORS
AND MINIMUM OPERATOR SPACE
ENVELOPE

(Second Revision)

ICS 53.100

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

NATIONAL FOREWORD

This Indian Standard (Second Revision) which is identical with ISO 3411 : 1995 'Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope' issued by the International Organization for Standardization (ISO), was adopted by the Bureau of Indian Standards on the recommendations of the Bulk Handling Systems and Equipment Sectional Committee and approval of the Heavy Mechanical Engineering Division Council.

This standard was first published in 1985. This (second) revision has been carried out to align it with ISO 3411:1995.

The text of ISO standard has been approved for publication as Indian Standard without deviations. Certain terminology and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

- a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
- b) Comma (,) has been used as a decimal marker in International Standard while in Indian Standards, the current practice is to use a full stop (.) as the decimal marker.

In the adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

<i>International Standard</i>	<i>Corresponding Indian Standard</i>	<i>Degree of Equivalence</i>
ISO 5353:1995 Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point	IS 11113:1999 Earth-moving machinery, and tractor and machinery for agriculture and forestry — Seat index point (<i>second revision</i>)	Identical
ISO 6165:1987 Earth-moving machinery — Basic types — Vocabulary	IS 12138:1993 Earth-moving machinery — Basic types — Vocabulary (<i>first revision</i>)	do
ISO 6682:1986 Earth-moving machinery — Zones of comfort and reach for controls	IS 11252:1993 Earth-moving machinery — Zones of comfort and reach for controls (<i>first revision</i>)	do

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

EARTH-MOVING MACHINERY — HUMAN PHYSICAL DIMENSIONS OF OPERATORS AND MINIMUM OPERATOR SPACE ENVELOPE

(Second Revision)

1 Scope

This International Standard defines the dimensions of male operators of earth-moving machinery and specifies the minimum normal operating space envelope around the operator enclosures (cabs, ROPS, FOPS) generally applicable to earth-moving machinery.

It applies to earth-moving machines as defined in ISO 6165.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5353:1995, *Earth-moving machinery, and tractors and machinery for agriculture and forestry — Seat index point*.

ISO 6165:1987, *Earth-moving machinery — Basic types — Vocabulary*.

ISO 6682:1986, *Earth-moving machinery — Zones of comfort and reach for controls*.

ISO 6682:1986/Amd.1:1989, Amendment 1.

3 Definitions

For the purposes of this International Standard, the following definitions apply (see figure 1).

3.1 small operator: Operator where only 5 % of the worldwide earth-moving machinery operator population is smaller than the dimensions given.

3.2 medium operator: Operator where 50 % of the worldwide earth-moving machinery operator population is smaller and larger than the dimensions given.

3.3 large operator: Operator where only 5 % of the worldwide earth-moving machinery operator population is larger than the dimensions given.

4 Physical dimensions of operators

4.1 General

The physical dimensions of small, medium and large operators are given in figures 2 and 3 for standing and sitting operators respectively. The body pivot dimensions for small, medium and large operators are given in figure 4.

NOTE 1 The dimensions of large and small earth-moving machinery operators were derived by combining national data to represent the worldwide operator population. Therefore a small number of the smallest and largest national operators will be smaller or larger respectively than the 5th and 95th percentile worldwide operator population. Nominally 75 mm of vertical seat adjustment is recommended to accommodate these operators. See ISO 6682:1986, annex A.

4.2 Dimensions

The dimensions given include an allowance for the height of shoes or boots and the thickness of work clothing. In the "large operator (arctic clothes)" column in tables of figures 2, 3 and 4, the dimensions are of uncompressed clothing (except where the operator is seated) with heavy mittened hands and the head covered with parka hood.

4.3 Erect posture

All dimensions are of an operator in an erect posture. A normal posture is "slumped" and the dimensions will be slightly less: stature (1A) and overhead reach (2A) will be reduced about 15 mm, while sitting chest height (3A) and sitting eye height (3B) will be reduced about 25 mm.

5 Minimum operator space envelope

5.1 The minimum operator space envelope is the interior dimension of the operator's enclosure. The minimum recommended operating space envelope around the clothed operator for operator enclosures (cabs, ROPS, FOPS) is given in figure 5 for a seated operator and in figure 6 for a standing operator. The dimensions given relate to the seat index point (SIP), as defined in ISO 5353.

The outline of the space envelope does not imply the shape of the enclosure. Potential adjustments to the minimum operator space envelope for particular machine applications and constraints are given in 5.3, 5.5 and 5.6.

5.2 The minimum operator space envelope is based on the large operator dimensions given in figures 2 and 3, and is measured to the interior surface without visible surface deformation of the operator enclosure.

5.3 The operator enclosure minimum space envelope may be smaller than specified in figures 5 and 6 if it can be demonstrated that the reduced operator space envelope for a particular machine application allows for adequate operator performance. Potential modifications for the operator enclosure space envelope include, but are not limited to the following.

5.3.1 An operator enclosure minimum height of 1 050 mm from the SIP is recommended to accommodate commonly used seats and provide clearance for an operator's protective helmet. The operator enclosure minimum height can be reduced to 1 000 mm for machines used predominantly in applications in which the operator normally does not wear a protective helmet. See ISO 5353 for details on SIP.

5.3.2 The enclosure height can also be adjusted for the following variations in seat configurations:

- a) 40 mm reduction without vertical seat suspension;
- b) 40 mm reduction without vertical seat height adjustment;
- c) adjustment for seat back rest angle greater than 15°.

5.4 The operator may be offset from the space envelope width centreline to allow direct visibility to the side of the machines, provided the minimum internal distance from the SIP to the side of the enclosure is at least 335 mm.

5.5 Some particular types of machines may necessitate use of an operator space envelope smaller than the minimum recommended by this International Standard. For these machines, the internal operator's space envelope width may be reduced to a minimum of 650 mm. This minimum width space envelope requires judicious placement of operator controls to ensure operator performance and comfort.

5.6 When the operator is normally inclined forward to operate the steering controls or access to a control to the rear of the SIP is required, the minimum clearance to the rear of the operator enclosure can be reduced to 250 mm plus one half of the fore-aft seat adjustment travel.

5.7 For the locations of controls, see ISO 6682.

NOTE 2 In some areas of the world, there are more than 5 % of the operators that have leg lengths less than the

values given for the small operators. To accommodate these areas of the world, special adjustments should be provided for zones of comfort and reach for the foot, as specified in ISO 6682:1986/Amd.1.

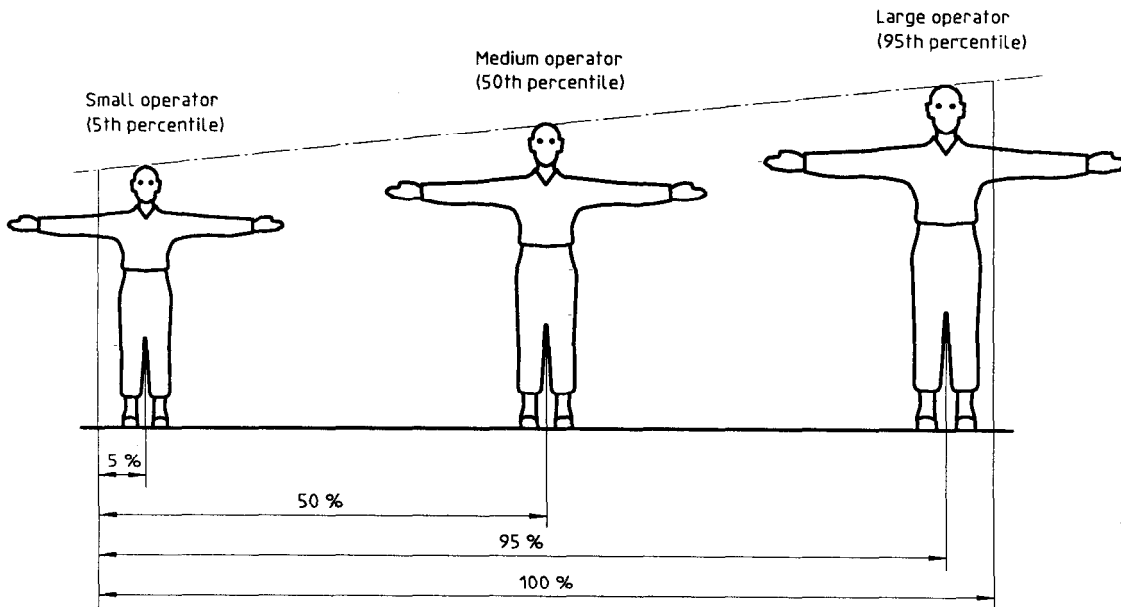
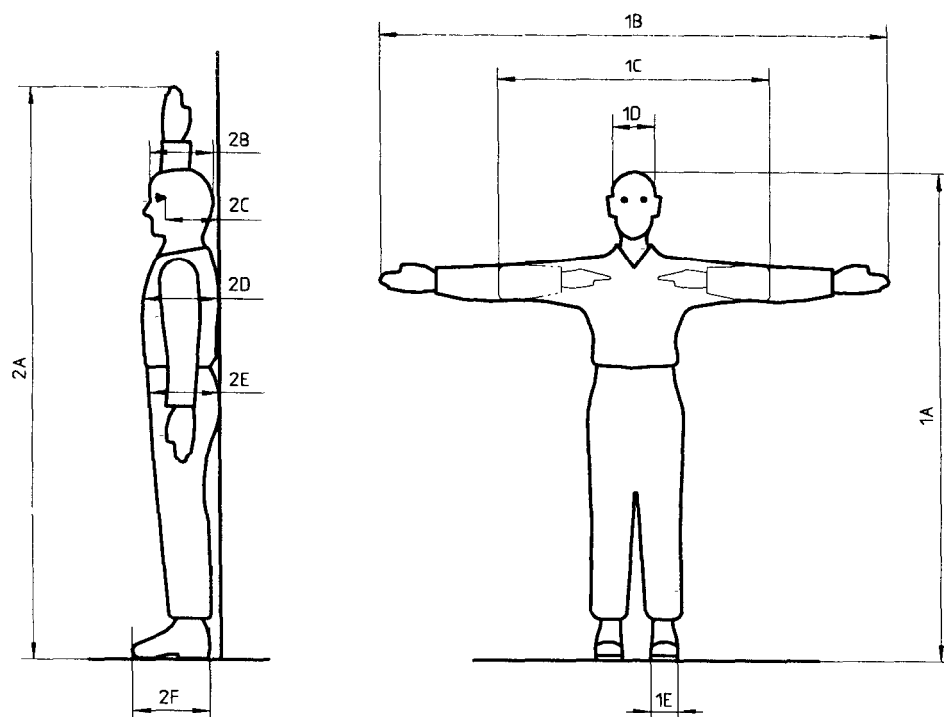


Figure 1 — Dimensions of operators

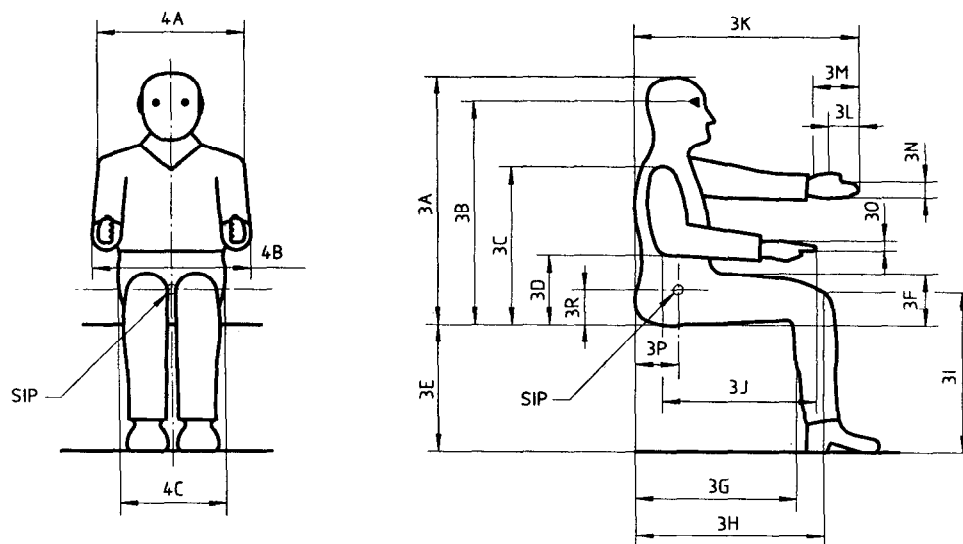


Dimensions in millimetres

Reference	Designation	Small operator (55 kg)	Medium operator (76,5 kg)	Large operator (98 kg)	Large operator (arctic clothes) (109 kg)
1A	Stature ^{1) 2)}	1 550	1 715	1 880	1 920
1B	Arm span	1 585	1 750	1 920	1 960
1C	Arm span, elbows folded	850	950	1 050	1 125
1D	Head width ^{3) 4)}	140	152	165	265
1E	Shoe width	95	105	115	140
2A	Overhead reach (fingertip) ²⁾	1 900	2 100	2 300	2 325
2B	Head length ⁴⁾	170	188	205	255
2C	Eye to back distance	170	188	205	245
2D	Chest depth	210	245	280	355
2E	Abdominal depth	210	255	300	400
2F	Shoe length	250	285	320	345

1) Add approximately 50 mm for protective helmet, except for the large operator (arctic clothes). See 4.2.
2) See 4.3.
3) Dimensions for head width do not include the ears.
4) Protective helmets: length: ≈ 310 mm; width: ≈ 270 mm
Helmets: length: ≈ 280 mm; width: ≈ 230 mm

Figure 2 — Dimensions for standing clothed operator



Dimensions in millimetres

Reference	Designation	Small operator	Medium operator	Large operator	Large operator (arctic clothes)
3A	Chest height, sitting ^{1) 2)}	800	880	960	990
3B	Eye height, sitting ²⁾	690	765	840	850
3C	Shoulder height	530	590	650	680
3D	Elbow height	200	235	270	260
3E	Horizontal sitting surface height	400	445	490	490
3F	Thigh thickness	120	145	170	200
3G	Back to calf distance	420	470	520	500
3H	Back to knee length	530	590	650	680
3I	Knee height	500	560	620	640
3J	Forearm to hand length	410	460	510	535
3K	Anterior arm reach	750	825	900	915
3L	Decrement for control grasp	-65	-72	-80	-85
3M	Hand length	170	188	205	210
3N	Hand width ³⁾	80	86	95	105
3O	Hand thickness ⁴⁾	25	30	35	45
3P	SIP length	113	125	137	147
3R	SIP height	80	88	97	107
4A	Shoulder width	380	440	500	540
4B	Elbow to elbow width	385	450	515	635
4C	Hip width, sitting	320	365	410	450

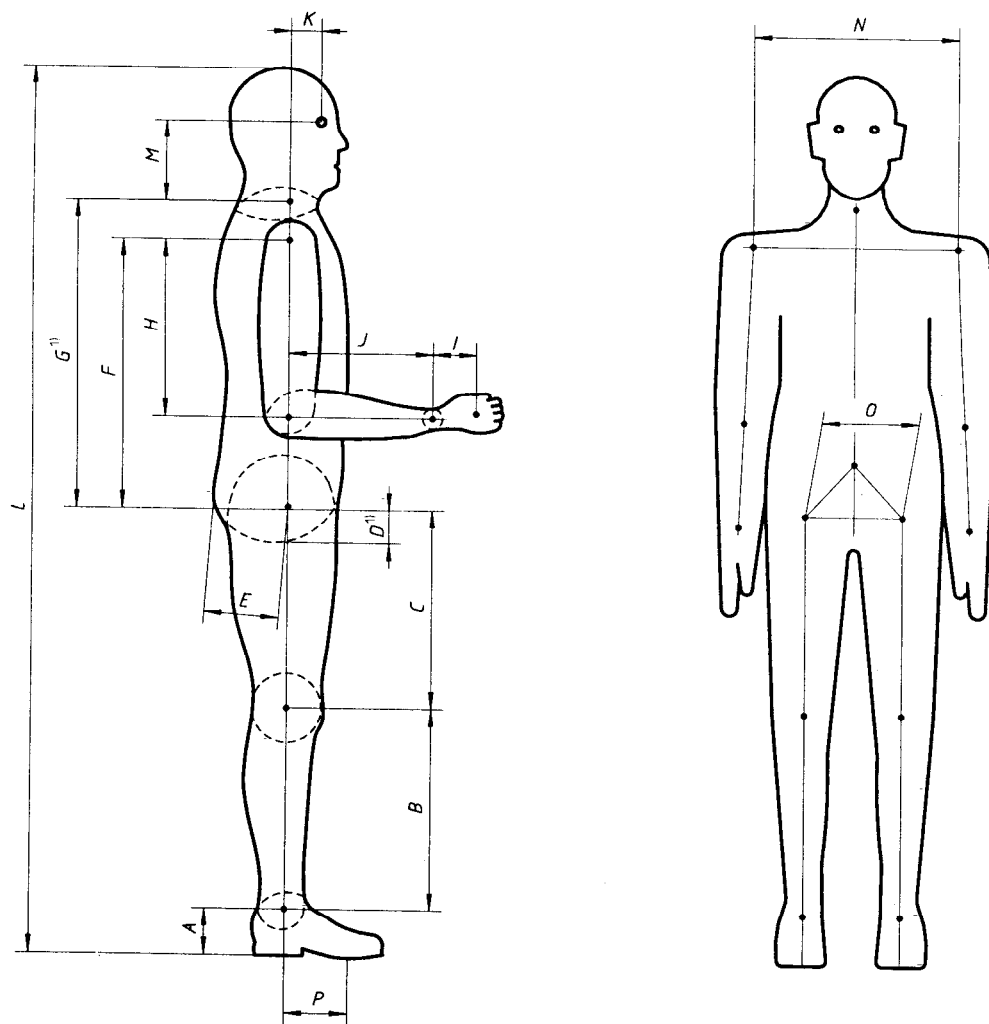
1) Add approximately 50 mm for protective helmet, if required, except for the large operator (arctic clothes).

2) See 4.3.

3) The dimension for hand width does not include the thumb.

4) The dimension for hand thickness relates to the thickness at the base of the fingers, not the palm thickness.

Figure 3 — Dimensions of sitting clothed operator



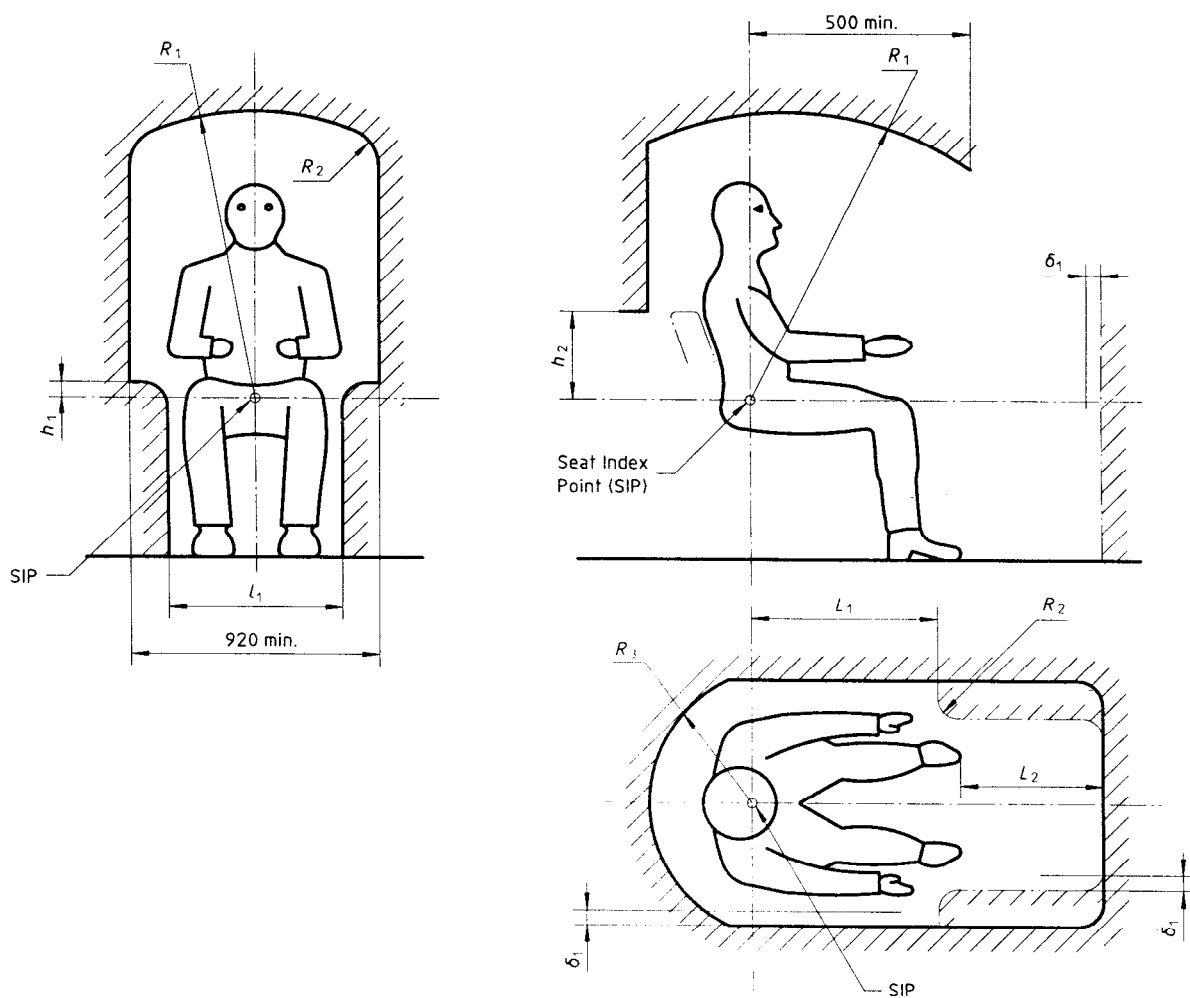
1) See table, footnote 1).

Dimensions in millimetres

Reference	Designation	Small operator	Medium operator	Large operator
<i>A</i>	Ankle height (with shoes)	98	109	119
<i>B</i>	Leg length	367	406	445
<i>C</i>	Thigh length	372	412	452
<i>D</i>	Hip point to buttock (vertical) ¹⁾	80	88	97
<i>E</i>	Hip point to buttock (fore-aft)	113	125	137
<i>F</i>	Trunk length	396	438	480
<i>G</i>	Hip point to neck pivot ¹⁾	481	533	584
<i>H</i>	Upper arm length	247	274	300
<i>I</i>	Wrist to control grasp	105	116	127
<i>J</i>	Forearm length	220	244	267
<i>K</i>	Eye to body centreline	71	78	86
<i>L</i>	Stature (with shoes)	1 550	1 715	1 880
<i>M</i>	Eye level to neck pivot	133	148	162
<i>N</i>	Shoulder pivot width	310	343	376
<i>O</i>	Hip pivot width	152	169	185
<i>P</i>	Ankle to pedal force point	124	137	150
NOTE — These dimensions are based on ISO 6682:1986, annex A.				
1) For the operator in the sitting position.				

Figure 4 — Body pivot dimensions

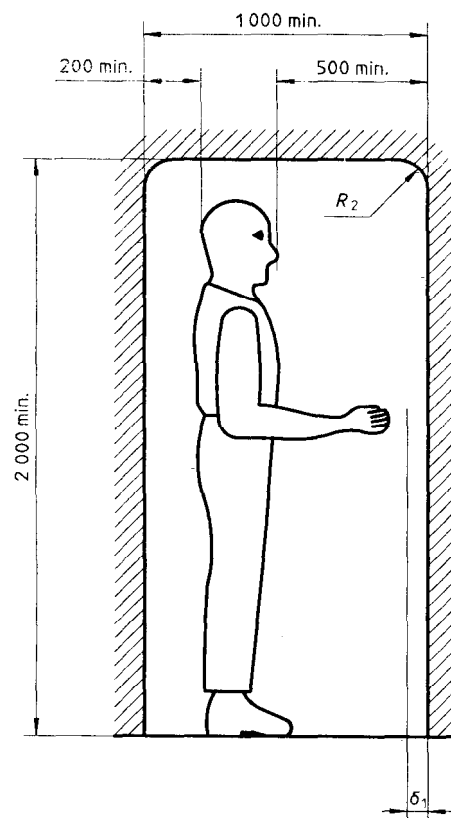
Dimensions in millimetres



NOTE — Dimensions are given in table 1.

Figure 5 — Operator minimum normal interior space envelope for enclosure — Seated clothed operator

Dimensions in millimetres



NOTE — Dimensions δ_1 and R_2 are given in table 1. Enclosure width dimensions and clearance for foot controls are the same as shown in figure 5.

Figure 6 — Operator minimum normal interior space envelope for enclosure — Standing clothed operator

Table 1

Dimensions in millimetres

Reference	Designation	Dimension
δ_1	Clearance between enclosure and controls at their closest to the enclosure	50 min.
R_1	Distance between SIP and the enclosure ceiling in the transverse plane: <ul style="list-style-type: none"> — with the operator wearing a protective helmet, on a seat with suspension and adjustment, where the machine has engine power above 150 kW — with the operator not wearing a protective helmet, on a seat with suspension and adjustment, where the machine has engine power between 30 kW and 150 kW — with the operator not wearing a protective helmet, on a seat that has neither suspension nor adjustment, where the machine has engine power less than 30 kW 	1 050 min. 1 000 min. 920 min.
R_2	Radius at the intersection of enclosure's internal walls with each other and with the ceiling	250 max.
R_3	Distance towards rear	1)
h_1	Vertical distance between SIP and the lower end of upper side walls of the enclosure	150 max.
h_2	Vertical distance between SIP and the lower end of upper back wall of the enclosure	2)
l_1	Width within the space for the legs	560 min.
L_1	Clearance for forearm/hand within the upper side areas of the enclosure	500 min.
L_2	Clearance between the enclosure and the operator's arctic shoe working a pedal or foot-control in any position	30 min.

1) At least $b + 400$ mm, where b is equal to half the horizontal seat adjustment dimension. See 5.6.

2) This dimension shall be equal to the vertical distance between the SIP and the top of the seat rest adjusted to its lowest position.

Annex A

(informative)

Bibliography

- [1] ISO 3449:1992, *Earth-moving machinery — Falling-object protective structures — Laboratory tests and performance requirements.*
- [2] ISO 3471:1994, *Earth-moving machinery — Roll-over protective structures — Laboratory tests and performance requirements.*
- [3] ISO 7250:—¹⁾, *Basic human body measurements for technological design.*

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Amendments Issued Since Publication

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